MICRONTA®

Service Manual

22-193

LCD Digital Autoranging Folding Multimeter

Catalog Number: 22-193

CUSTOM MANUFACTURED FOR RADIO SHACK, A DIVISION OF TANDY CORPORATION

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WARNING: These servicing instructions are for use by qualified personnel only. To avoid electric shock, do not perform any servicing other than that contained in the operating instructions unless you are qualified to do so.

SPECIFICATIONS

Display: 3½-Digit, LCD

Accuracy

	Nominal	Limit
DC VOLTS 200mV-2-20-200-2000V (Maximum measurement = 1000 Volts)	±0.8% of reading ±0.2% of full scale ±1 in last digit	±1.0% of reading ±0.2% of full scale ±1 in last digit
AC VOLTS 2-20-200-2000V (Maximum measurement = 500 Volts RMS) at 50/60 Hz	±1% of reading ±0.5% of full scale ±1 in last digit	±1.5% of reading ±0.5% of full scale ±1 in last digit
45 to 1 kHz on 20 Volt Range	±1.5% of reading ±0.5% of full scale ±1 in last digit	
to 10 kHz on 20 Volt Range	±6% of reading ±0.5% of full scale ±1 in last digit	
DC-CURRENT 200mA, 10A	±1.5% of reading ±0.2% of full scale ±1 in last digit	±2.5% of reading ±0.2% of full scale ±1 in last digit
AC-CURRENT 200mA, 10A	±1.5% of reading ±0.5% of full scale ±1 in last digit	±2.5% of reading ±0.5% of full scale ±1 in last digit
RESISTANCE 200Ω-2-20-200-2000 kΩ	±1.5% of reading ±0.2% of full scale ±1 in last digit +18 digits maximum at 200Ω	±2.0% of reading ±0.2% of full scale ±1 in last digit

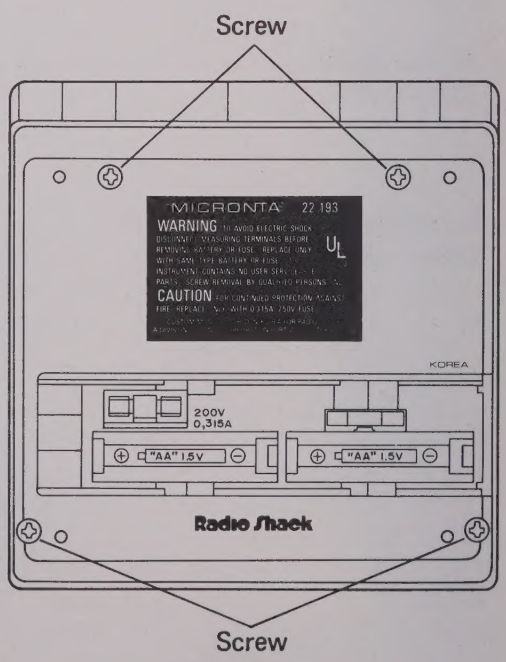
Continuity Function	Continuity buzzer sounds at less than 300 ohm input resistance (Nominal Spec.) at less than 500 ohm input resistance (Limit Spec.)
Diode Check Function	For checking if semiconductors are open, shorted or normal.
Input Impedance	10 megohm (DCV/ACV) more than 100 megohm on 200mV DC
Range Selection	Automatic ranging with RANGE-HOLD function
Power Source	Two AA size 1.5V batteries
Power Consumption	6mW typical, 15mW at continuity function
Low Battery Indication	"BATT" on the left of display Below 1.2 – 1.3V per cell
Polarity	Automatic polarity
Over-range Indication	1000 with blinking "1"
Detent	90°, 120°, 150°, 180°
Operating Temperature	0°C to 50°C
Storage Temperature	–20°C to 60°C
Weight	500g (1.1 lb)
Size	278 x 145 x 37mm (10-9/10" x 5-7/10" x 1-1/2") Fully Open 153 x 145 x 52mm (6" x 5-7/10" x 2-1/16") Fully Closed
Accessories	Fuse: 0.315A 250V (Radio Shack Cat. No. 270-1249) Banana Type Test leads (Radio Shack Cat. No. 278-704)

NOTE: **Nominal specs** represent the design specs; all units should be able to approximate these – some will exceed and some may drop slightly below these specs.
Limit specs represent the absolute worst condition which still might be considered acceptable; in no case should a unit perform to less than within any limit spec.

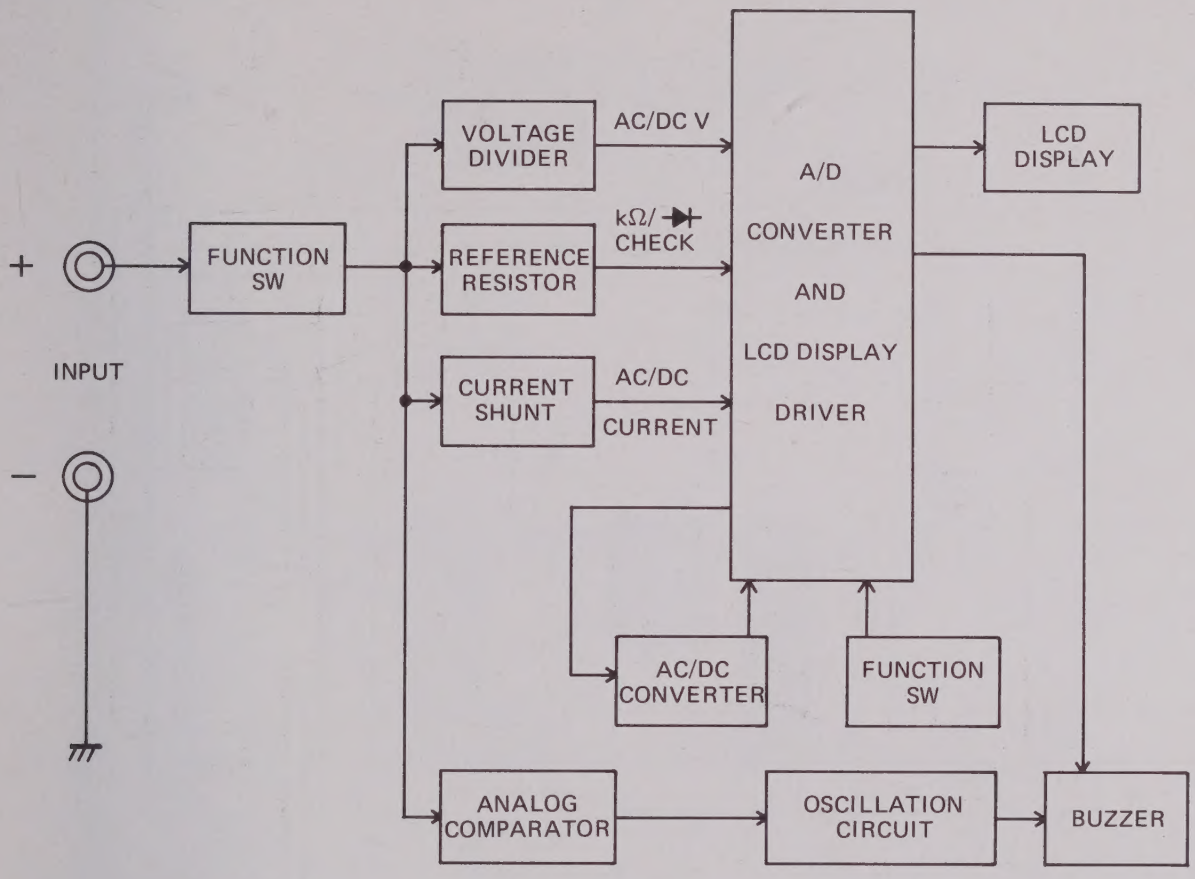
DISASSEMBLY INSTRUCTIONS

1. Remove battery cover from bottom cabinet, then remove batteries.

2. Remove four screws from bottom cabinet.



BLOCK DIAGRAM AND GENERAL CIRCUIT DESCRIPTION



GENERAL CIRCUIT DESCRIPTION

The Micronta LCD Digital Multimeter operates around the IC (SXC1901F) Chip. The 1901F consists of a dual-slope A/D (Analog-to-Digital) converter and a display drive.

Since the 1901F measures voltage only, other measured parameters must be converted by the peripheral circuitry. To measure current, shunt resistors are used. To measure unknown resistance, a known value of constant current is applied and the voltage is measured.

When checking continuity, oscillation circuit operates through analog comparator to sound buzzer.

AC/DC VOLTAGE MEASUREMENT

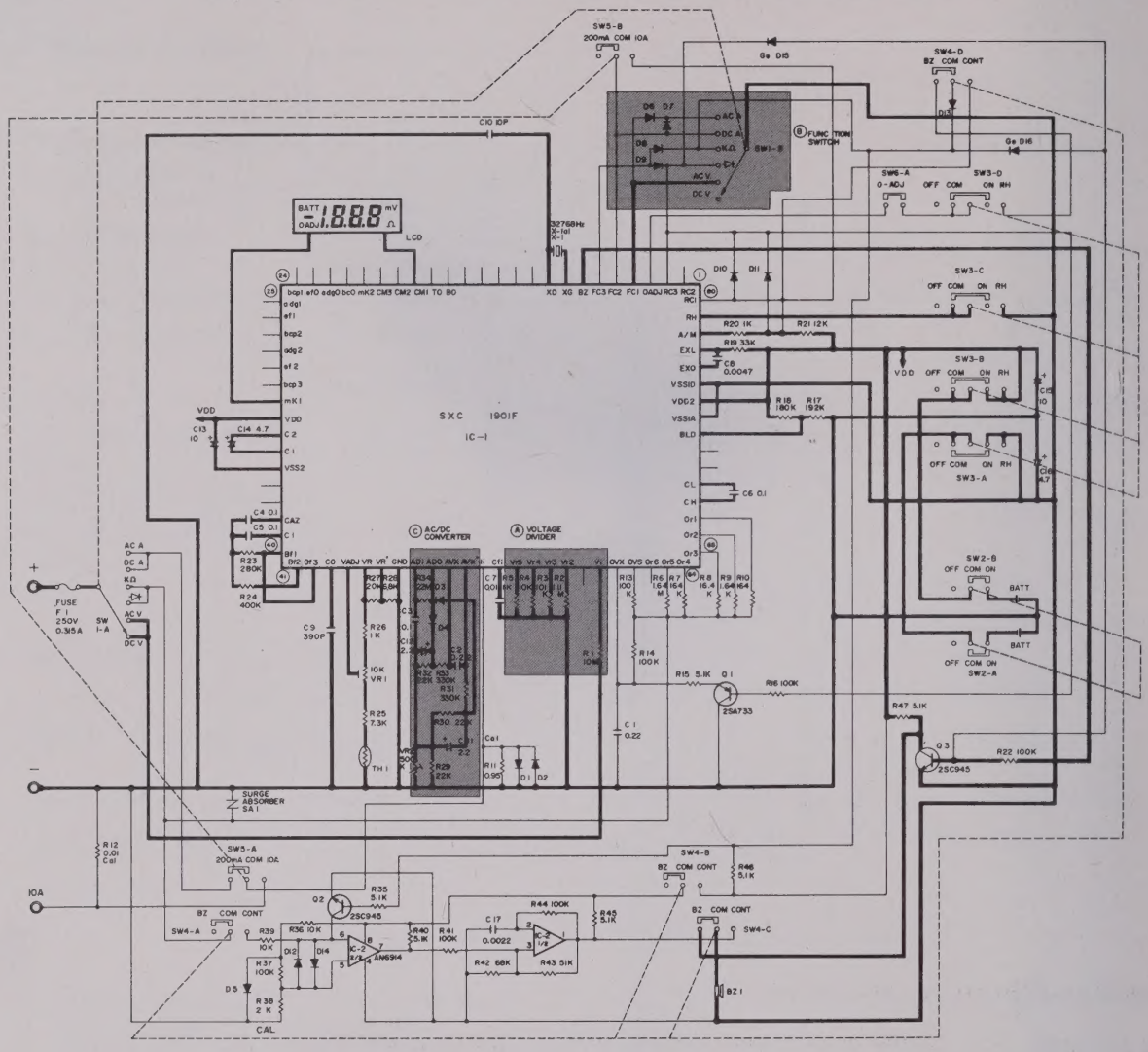


Figure 1-1 Diagram of AC/DC Voltage Check

The inputted voltage first enters voltage divider (labelled Ⓐ in Figure 1-1) through fuse and function switch (SW1-A). The range is automatically changed to the suitable range for the inputted voltage by the inner action of IC1. If function switch (labelled Ⓑ in figure 1-1) is set to ACV when ACV is inputted, the output from voltage divider is inputted to AC/DC converter (labelled Ⓒ in figure 1-1) and rectified, by the action of analog switch in IC1. The DC voltage of divider output or the AC voltage of AC/DC converter output is compared in IC1 with the reference voltage, and the result is displayed on LCD.

AC/DC CURRENT MEASUREMENT

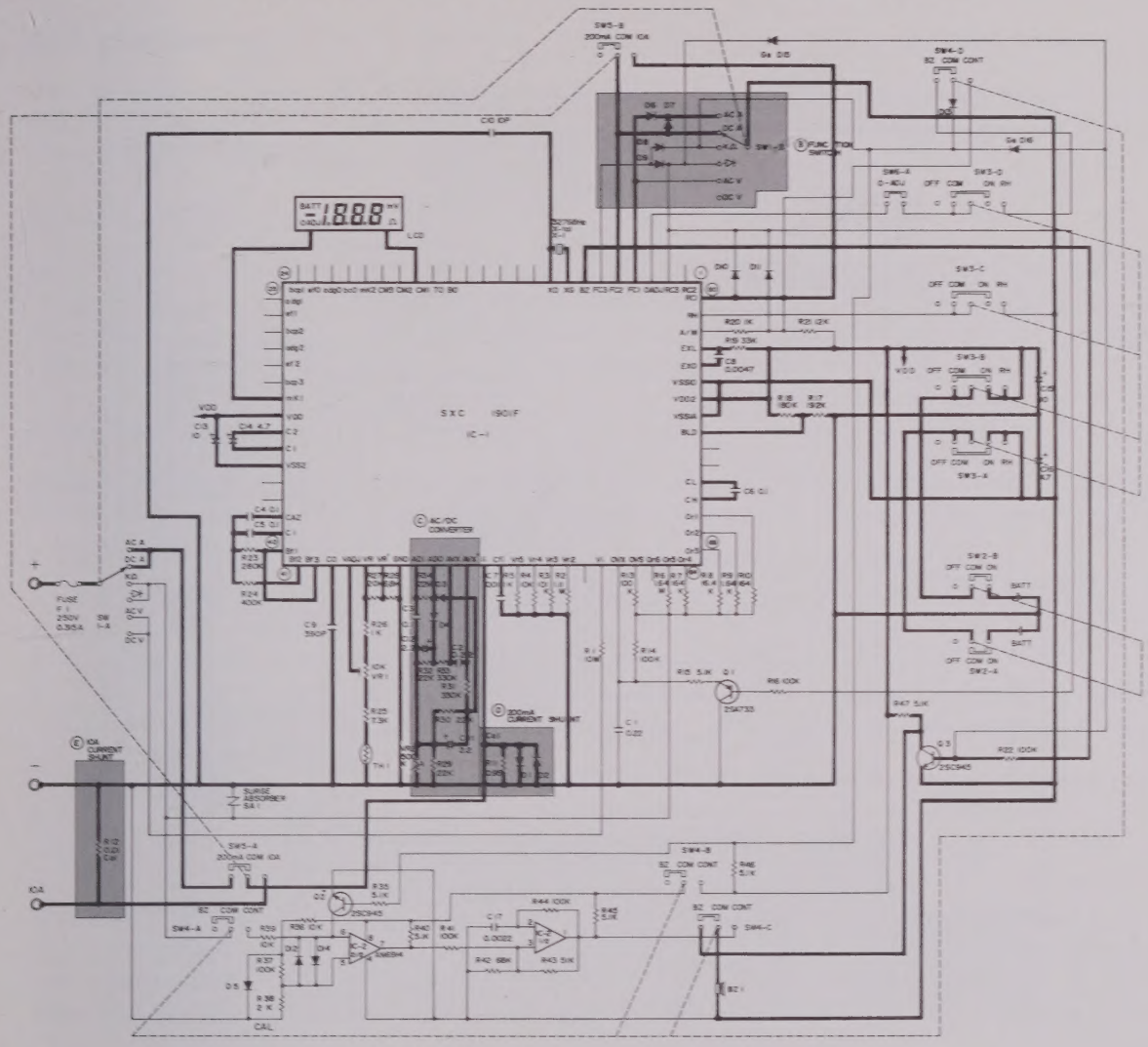


Figure 1-2 Diagram of AC/DC Current Check

When measuring AC/DC 200mA range, the 200mA-10A switch (SW5) should be set to the 200mA position. The inputted current first enters 200mA current shunt (labelled Ⓓ in figure 1-2. 9.5Ω, R11) through fuse, function switch (SW1-A) and the 200mA-10A switch (SW5-A).
When measuring AC/DC 10A range, the 200mA-10A switch (SW5) should be set to the 10A position. The inputted current first enters 10A current shunt (labelled Ⓔ in figure 1-2. 0.01Ω, R12) through 10A terminal (not fuse-protected), then enters current shunt Ⓓ through SW5-A.
If function switch (SW1-B) is set to ACA when ACA is inputted, the output from current shunt Ⓓ is inputted to AC/DC converter and rectified, by analog switch in IC-1. The DC voltage of current shunt output or the AC voltage of AC/DC converter output is compared in IC with the reference voltage, and the result is displayed on LCD.

RESISTANCE MEASUREMENT

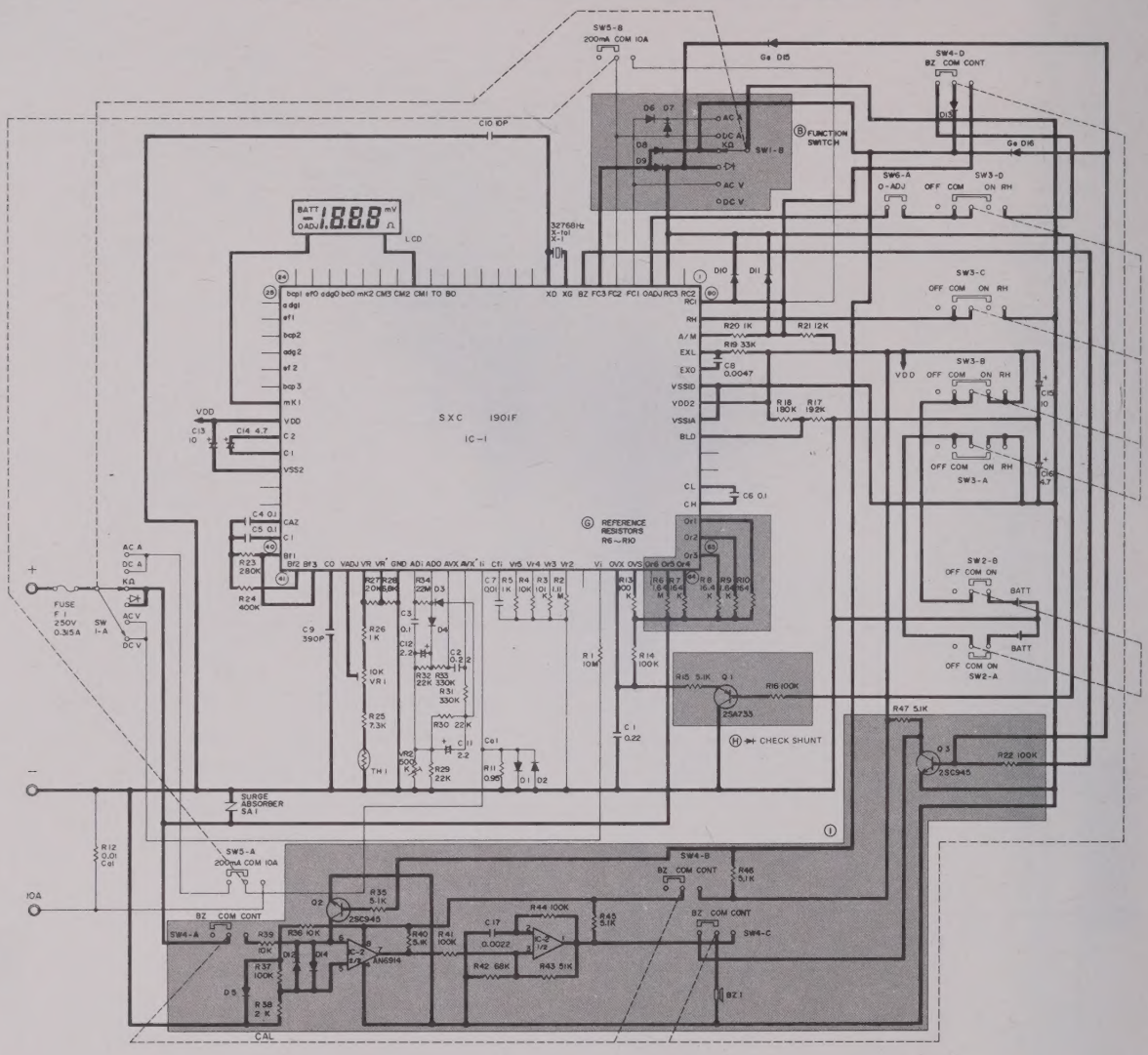


Figure 1-3 Diagram of Resistance Check

A ratio technique is used. When the function switch (labelled Ⓑ in figure 1-3) is set to KOHM, a series circuit is formed by the internal reference voltage, the selected reference resistor (labelled Ⓖ in figure 1-3) and the resistance to be measured.
The ratio of the two resistors is equal to the ratio of their respective voltage drops. Since the value of the reference resistor is known, the 1901F A/D converter calculates the value of the unknown resistor as follows.

in the case of integration:

$$V_0\ (INT) = \frac{R \times (\text{Unknown Resistance})}{R_{ref}\ (\text{Reference Resistor}) + R \times (\text{Unknown Resistance})} \times V_{ref}$$

in the case of de-integration:

$$V_0\ (DE) = \left(1 - \frac{Rx}{R_{ref} + Rx}\right) \times V_{ref} = \frac{R_{ref}}{R_{ref} + Rx} \times V_{ref}$$

$$\frac{V_0\ (INT)}{V_0\ (DE)} = \frac{Rx}{R_{ref}}$$

0-ADJ Function

The internal resistance affects reading on the 200Ω range. When using 0-ADJ function, the internal resistance (fuse and line resistances) is suppressed to 00 on the display (the zero level is changed) when the test leads are shorted.

Continuity Check

When the BUZZER-CONTINUITY switch is set to the CONTINUITY position in the K OHM range, the range is held at 20 KΩ range automatically and the oscillation circuit (labelled (I) in figure 1-3) starts operating. The circuit compares the inputted analog value in IC-2 (not in IC-1 (1901F)), then sounds beep if the value is under 300Ω nominal.

Diode Check

Since open-circuit voltage between input jacks is maintained at 1.5 Volts (when in the ⇥ CHECK function), you can check continuity of most diodes, transistors, etc. The shunt for diode check is labelled (H) in figure 1-3.

1. Set the function switch to the ⇥ CHECK position. The range is automatically set to 200Ω.
2. Remove power from the circuit under test.
3. Connect probes to the semi conductor device you want to check.
4. If the device is good, the display will show some value. If over-range occurs, try reversing polarity: if over-range still occurs, the device is open. If reading is zero, the device is shorted.

IC DESCRIPTION

The 1901F chip is a high-performance, low power CMOS 3½ digit analog/digital converter. All necessary active devices are present including seven-segment decoder/driver, reference voltage and internal clock.
Clock frequency is 32 kHz and the reference voltage is 164 (mV).

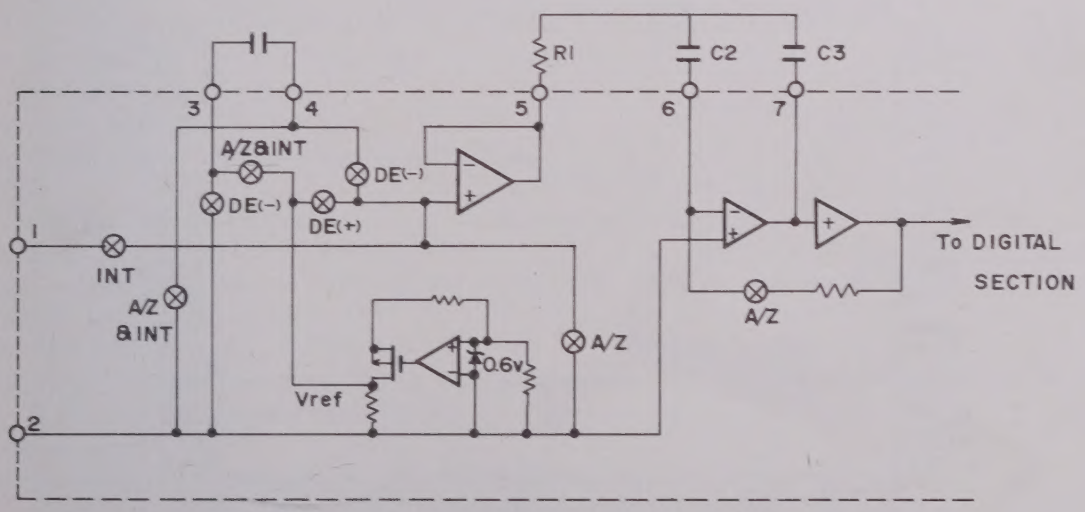


Figure 2 Analog Section of IC

The analog section of the chip operates in three steps.

1. AUTO-ZERO (A/Z): Internal circuitry compensates for input-offset voltage errors during measurement.
2. INTEGRATE (INT): Input voltage is applied to pins 1 & 2. After being buffered, the voltage is applied to capacitor C3, which is charged to a level proportional to the input.
3. DE-INTEGRATE (DE): C3 is discharged by the reference voltage (164 mV) which is opposite to the input in polarity. The time required for discharge is proportional to the unknown input voltage. The discharge time is transferred to a series of latches and passed on to the digital section of the 1901F. At this point, the chip is returned to auto-zero (Figure 4). In the digital section of the 1901F, the C3 discharge time previously inputted from the analog section is translated to digital information, compared with the clock output, fed through seven segment decoders and a phase driver, and to the 3½ digit LCD display (Figure 3).

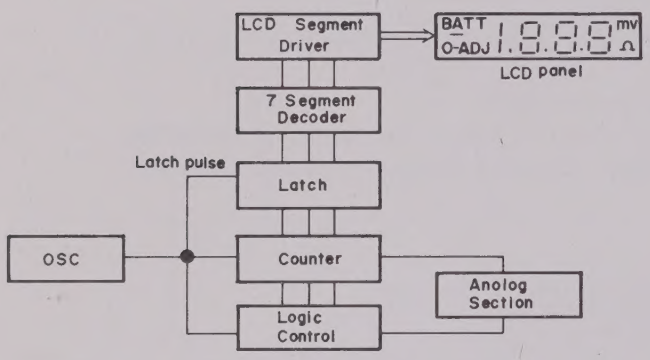


Figure 3 IC Block Diagram

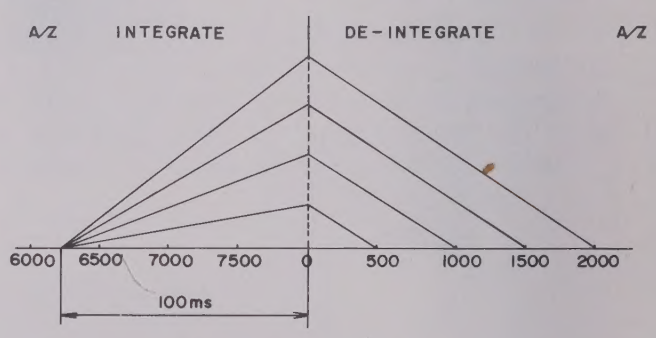


Figure 4 IC Operating Timing

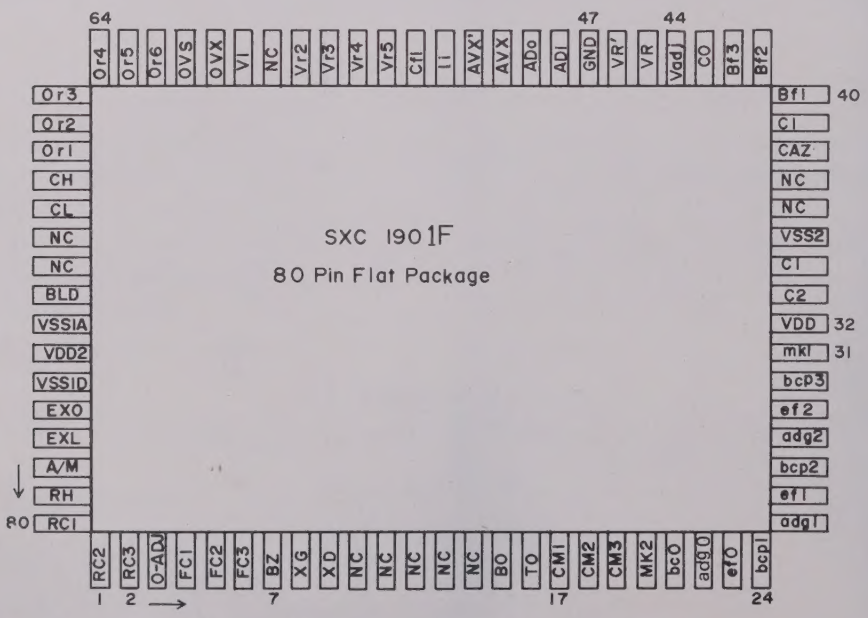


Figure 5 IC Pin Configuration

LCD PIN CONFIGURATION

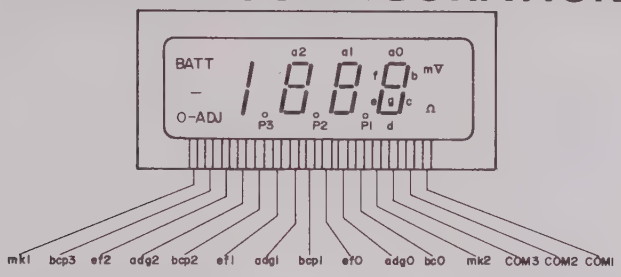


Figure 6

CALIBRATION AND CHECK

Equipment Required:

1. AC CALIBRATOR 0-750V (±0.1% accuracy, 50 Hz-1 kHz)
2. DC CALIBRATOR 0-1000V (±0.05%)
3. DC/AC CURRENT CALIBRATOR 0-200mA (±0.2%)/10A (±0.2%)
4. RESISTOR 1 kΩ, 10 kΩ (±0.1%)

Procedure:

1. DC Voltage:

1. Power ON.
2. Set function switch to DCV.
3. Connect DC voltage calibrator.
4. Apply 1.800 VDC to input.
5. Adjust VR1 (10 kΩ) so display reads 1.800.
6. Disconnect DC voltage calibrator.

2. AC Voltage:

1. Set function switch to ACV.
2. Connect AC voltage calibrator.
3. Apply 1.800 VAC to input. (50 or 60 Hz).
4. Adjust VR2 (500 kΩ) so display reads 1.800.
5. Disconnect AC voltage calibrator.

3. DC Current:

200 mA:

1. Set function switch to DC A.
2. Set 200 mA-10A switch to 200 mA.
3. Connect DC current calibrator to input (+) jack and input (—) jack.
4. Apply 180.0 mA DC to input.
5. Check display if it reads figures within spec.

10A:

1. Set function switch to DC A.
2. Set 200 mA-10A switch to 10A.
3. Connect DC current calibrator to input 10A jack and input (—) jack.
4. Apply 10.00 A DC to input.
5. Adjust the position of the lag on the resist wire R12 so that the display reads 10.00.

4. Resistance:

1. Set function switch to kΩ, with BUZZER-CONTINUITY switch in the BUZZER position.
2. Connect calibration resistance (1 kΩ and/or 10 kΩ) to input.
3. Check display if it reads figures within spec.
4. Disconnect calibration resistance.

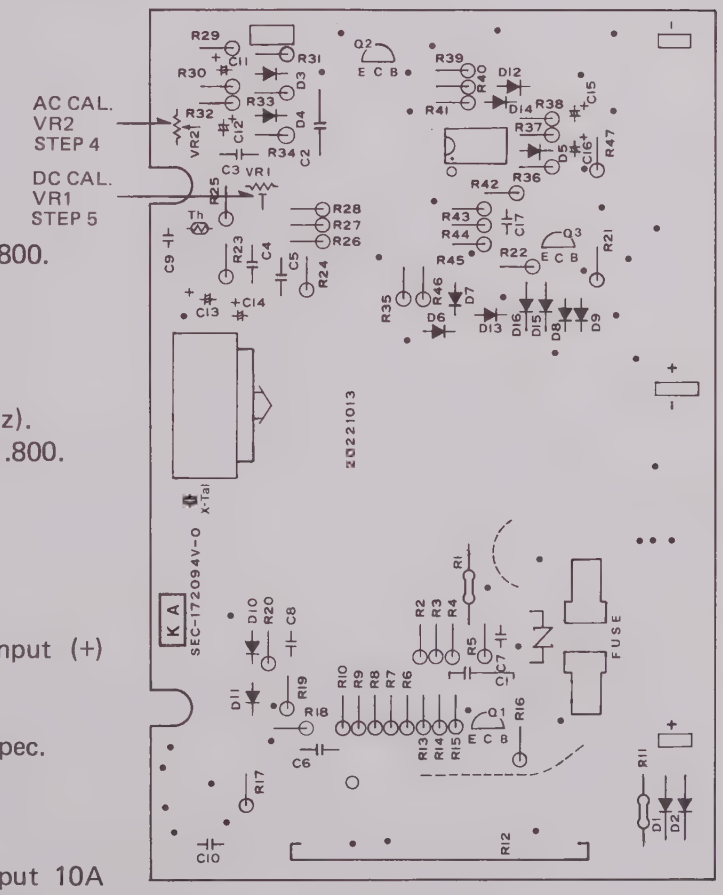


Figure 7 Calibration Points

TROUBLESHOOTING HINTS

Preliminary Checks

1. Check battery (polarity, contact, voltage, etc.)
2. Check the PCB components for obvious opens-shorts and the contact and continuity of fuse.
3. Check test leads for breaks, fully connections, etc.

CHECK BEFORE OPERATION

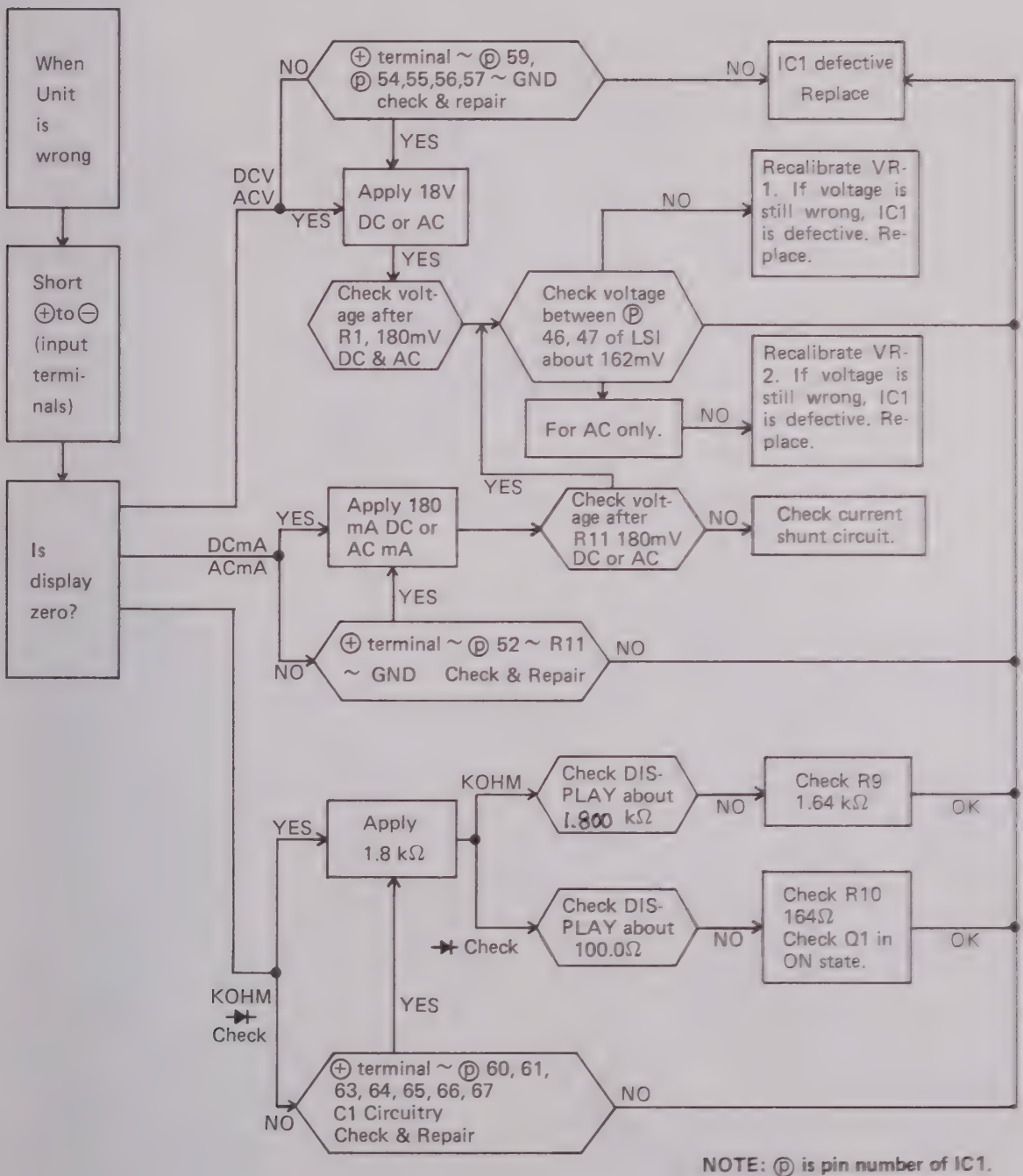
1. Plug the red test lead into the (+) jack, and the black test lead into (—) jack.
2. Turn **POWER** on.
3. Turn the function switch to k OHM.
4. With no resistance connected across the test leads, the over-range indication should occur, and display will show "1000" with blinking 1. Short the test leads; the display now should be three zeroes.

200 OHM Range	100.0	000	2000 k OHM Range
2 k OHM Range	1.000 ↓	↓ 00.0	200 k OHM Range
20 k OHM Range	10.00 ↓	↓ 0.00	20 k OHM Range
200 k OHM Range	100.0 ↓	↓ .000	2 k OHM Range
2000 k OHM Range	1000 ↓	↓ 00.0*	200 OHM Range

*Actually shows small resistance value of internal circuit.

<table>
<tr><th>SYMPTOM</th><th>ITEM TO CHECK</th></tr>
<tr><td>No function change when function switch (SW1) is rotated.</td><td>1) Common of (SW1-2) goes down to —V.
2) Contact and wiper of (SW1-2) make good contact.
3) IC1 pins 4, 5, 6 (FC1, FC2, FC3) work as follows.
<table>
<tr><th></th><th>DCV</th><th>ACV</th><th>DC A</th><th>AC A</th><th>KOHM</th><th>→+CHECK</th></tr>
<tr><td>FC1</td><td>H</td><td>L</td><td>H</td><td>L</td><td>H</td><td>H</td></tr>
<tr><td>FC2</td><td>H</td><td>H</td><td>L</td><td>L</td><td>H</td><td>H</td></tr>
<tr><td>FC3</td><td>H</td><td>H</td><td>H</td><td>H</td><td>L</td><td>L</td></tr>
</table></td></tr>
<tr><td>Display does not show 000 with + — terminals are shorted.</td><td>1) Contact and continuity of fuse.
2) Contact, wiper, and continuity of SW1-A.</td></tr>
<tr><td>Range display is unstable, all modes.</td><td>Shield sheet (upper and lower) and for good contacts.</td></tr>
<tr><td>0-ADJ does not operate when 0-ADJ button is pressed.</td><td>1) Function switch is in KOHM position, BUZZER — CONTINUITY switch is in BUZZER position and POWER switch is in RANGE HOLD position.
2) Circuit for open between IC-1 pin 3 — 0-ADJ switch (SW-6) — —V.</td></tr>
<tr><td>Range hold does not operate.</td><td>Circuit for open between IC1 pin 79 — Power SW (SW2-3) — —V.</td></tr>
<tr><td>The displaying digit of LCD is dim or some segment does not light.</td><td>Circuit for open between LCD — Heat Seal — PCB — IC1 pin.</td></tr>
<tr><td>No buzzer sound. (SW-4 is in BUZZER position.)</td><td>1) Pin 7 of IC-1 oscillates.
2) Contacts of SW-4 make good contact.</td></tr>
<tr><td>No buzzer sound. (SW-4 is in CONTINUITY position.)</td><td>1) Pin 1 of IC-2 oscillates.
2) Contacts of SW-4 make good contact.</td></tr>
</table>

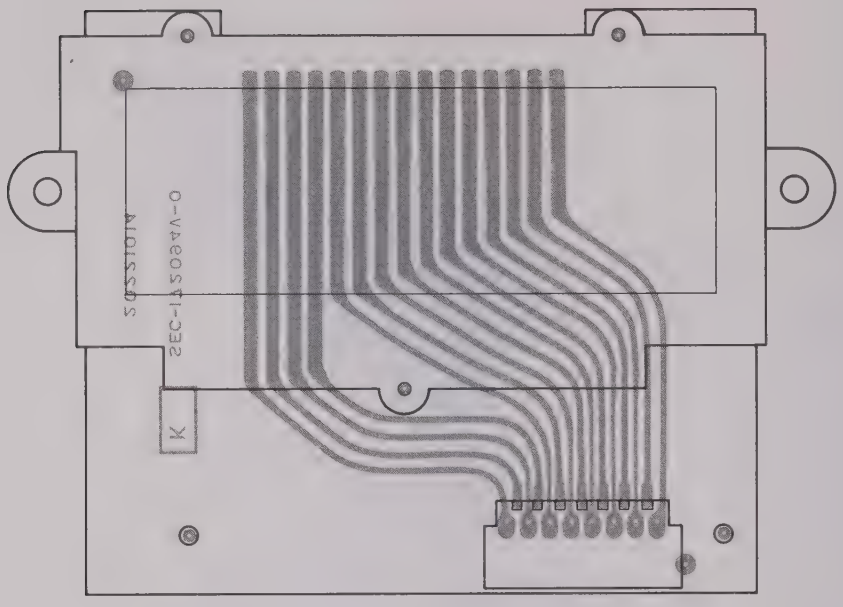
Troubleshooting of Circuit

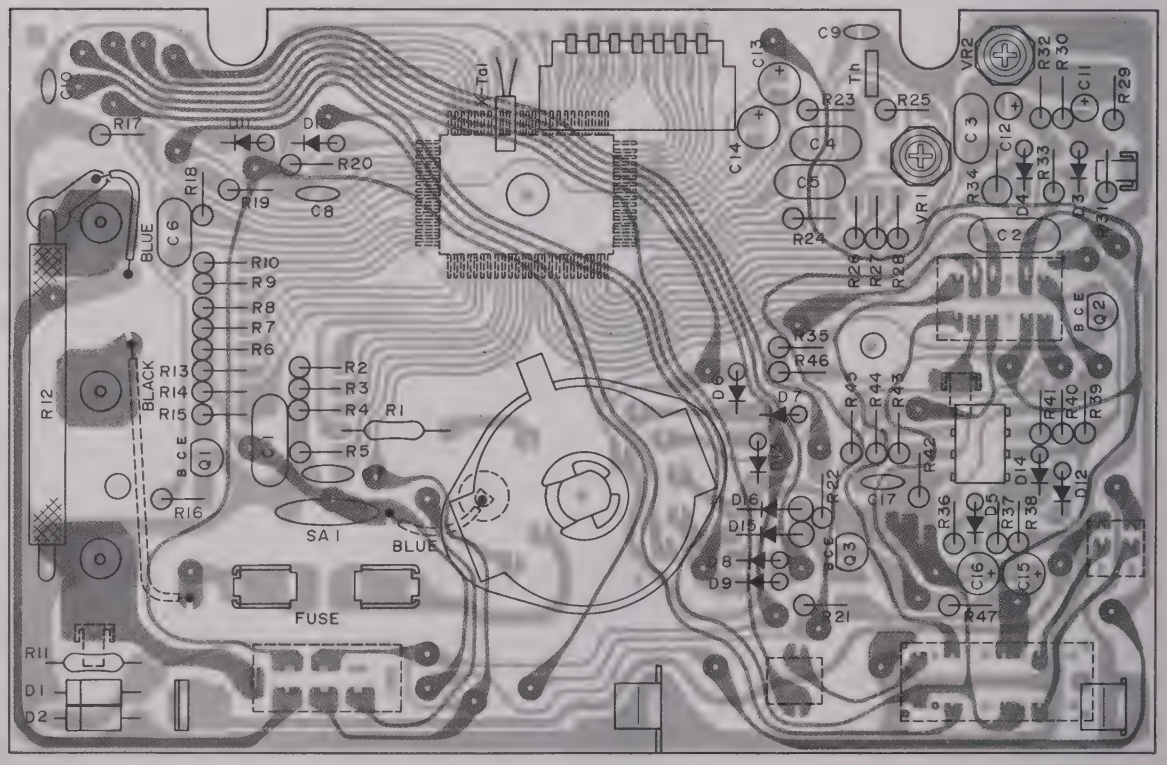

When Unit is wrong
Short ⊕to⊖ (input terminals)
Is display zero?
DCV ACV
DCmA ACmA
KOHM Check
NO
YES
⊕ terminal ~ ⓟ 59, ⓟ 54,55,56,57 ~ GND check & repair
IC1 defective Replace
Apply 18V DC or AC
Recalibrate VR-1. If voltage is still wrong, IC1 is defective. Replace.
Check voltage after R1, 180mV DC & AC
Check voltage between Ⓟ 46, 47 of LSI about 162mV
Recalibrate VR-2. If voltage is still wrong, IC1 is defective. Replace.
For AC only.
Apply 180 mA DC or AC mA
Check voltage after R11 180mV DC or AC
Check current shunt circuit.
⊕ terminal ~ ⓟ 52 ~ R11 ~ GND Check & Repair
Apply 1.8 kΩ
Check DISPLAY about 1.800 kΩ
Check R9 1.64 kΩ
OK
Check DISPLAY about 100.0Ω
Check R10 164Ω Check Q1 in ON state.
Check
⊕ terminal ~ ⓟ 60, 61, 63, 64, 65, 66, 67 C1 Circuitry Check & Repair

NOTE: ⓟ is pin number of IC1.

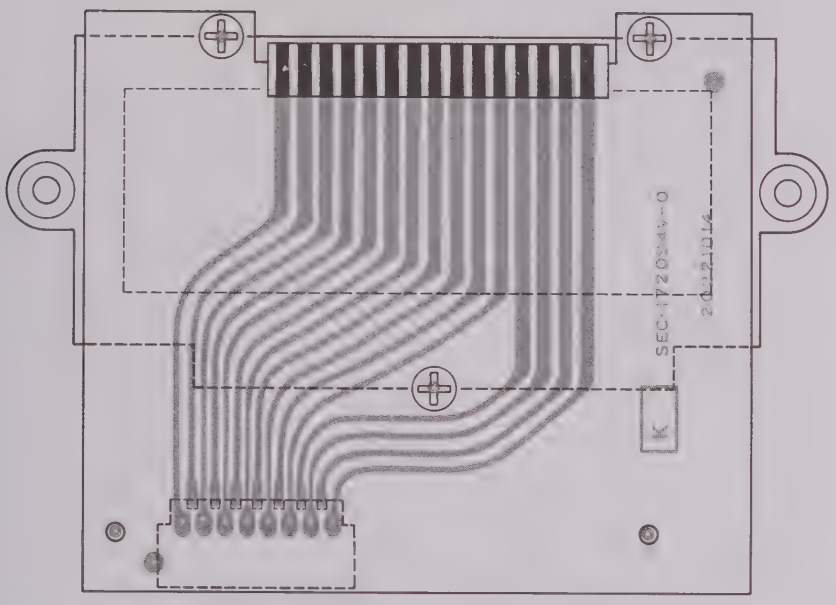
PRINTED CIRCUIT BOARD
(TOP & BOTTOM VIEWS)

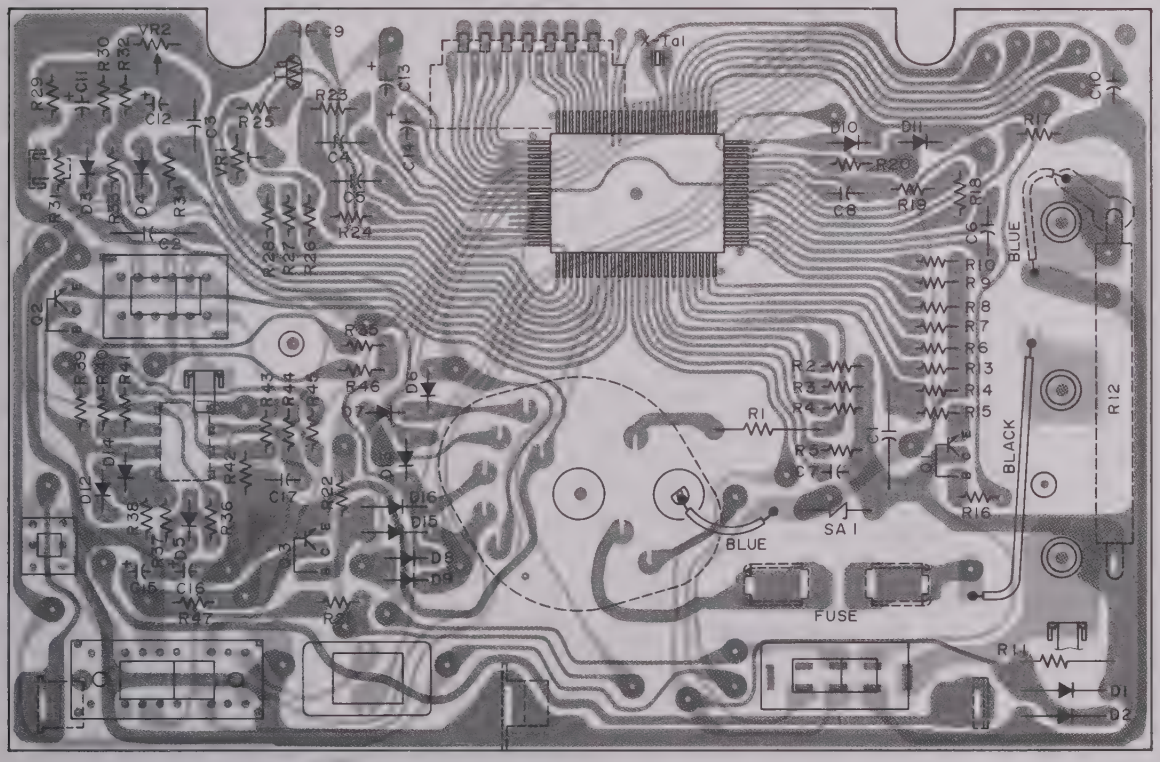
TOP VIEW



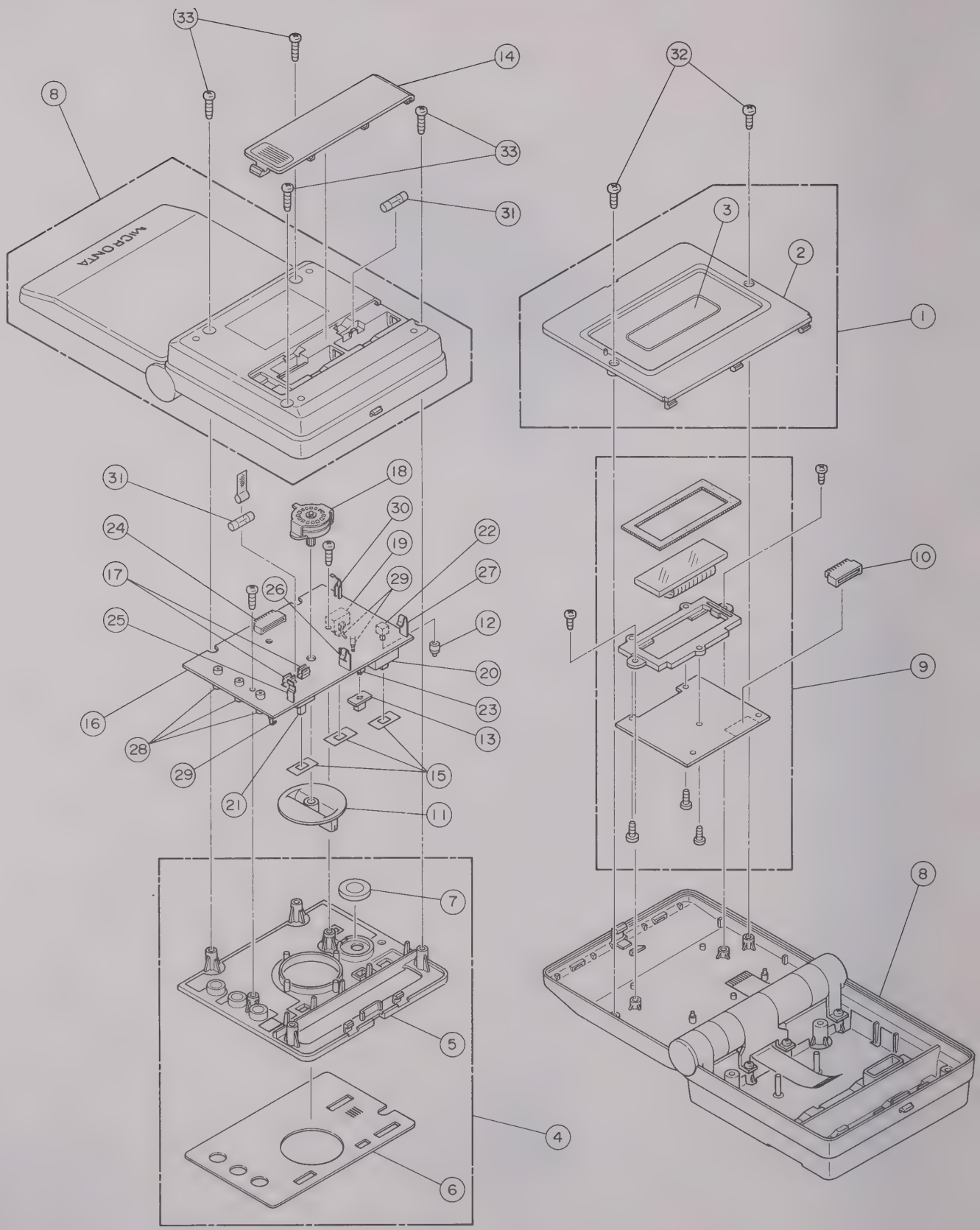


BOTTOM VIEW




VR2
R29
R30
R32
C11
C12
C3
VR1
R25
R23
C4
C5
R24
R28
R27
R26
C2
Q2
R33
R34
R35
R46
D6
D7
R45
R44
R43
R42
C17
D12
R38
R37
R36
D5
C16
R47
R22
D16
D15
D8
D9
R21
C13
Tal
D10
D11
R20
C8
R19
R18
C9
R17
C10
R10
R9
R8
R7
R6
R13
R14
R15
R2
R3
R4
R5
C7
Q3
R16
R1
C1
SA1
BLUE
BLACK
FUSE
R12
R11
D1
D2

EXPLODED VIEW



ELECTRICAL PARTS LIST

BUZZER

Ref. No.	Description	RS Part No.	Mfr's Part No.
BZ1		B-7110	272010010A

CAPACITORS

Ref. No.	Description				RS Part No.	Mfr's Part No.
C1	M-Plastic	0.22μF	100V	±10%	CC-224KLYP CC-224KLYP	CFQMN224KU or CFQMN224KR
C2	M-Plastic	0.22μF	100V	±10%	CC-224KLYP CC-224KLYP	CFQMN224KU or CFQMN224KR
C3	*Mylar® Polyester Film Disk Capacitor	0.1μF	50V	±10%	CC-104JJMP	CQQBK104KF
C4	Mylar	0.1μF	50V	±10%	CC-104JJMP	CQQBK104KF
C5	Mylar	0.1μF	50V	±10%	CC-104JJMP	CQQBK104KF
C6	Mylar	0.1μF	50V	±10%	CC-104JJMP	CQQBK104KF
C7	Mylar	0.01μF	50V	±10%	CC-103JJMP	CQQMK103K*
C8	Mylar	0.0047μF	50V	±10%	CC-472JJMP	CQQMK472K*
C9	Ceramic	390pF	50V	±10%	CC-391JJCP	CKJEK391K*
C10	Ceramic	10pF	50V	±1pF	CF-1145	CCJBK100F*
C11	Tantalum or equiv.	2.2μF	16V	±20%	CC-225MDTP	CSEEG225M* or
		2.2μF	25V	±20%	CC-225MFTP	CSEEI225M* or
		2.2μF	35V	±20%	CC-225MGTP	CSEEJ225M*
C12	Tantalum or equiv.	2.2μF	16V	±20%	CC-225MDTP	CSEEG225M* or
		2.2μF	25V	±20%	CC-225MFTP	CSEEI225M* or
		2.2μF	35V	±20%	CC-225MGTP	CSEEJ225M*
C13	Electrolytic	10μF	25V	±20%	CC-106MFAP	CEBCI106M*
C14	Electrolytic	4.7μF	50V	±20%	CC-475MJAP	CEBCK475M*
C15	Electrolytic	10μF	25V	±20%	CC-106MFAP	CEBCI106M*
C16	Electrolytic	4.7μF	50V	±20%	CC-475MJAP	CEBCK475M*
C17	Mylar	0.0022μF	50V	±10%	CC-222JJMP	CQQMK222K*

DIODES

Ref. No.	Description			RS Part No.	Mfr's Part No.
D1–D2	Silicon	SR1K-4	Protector	DX-0476	SDSI00027–
D3–D14	Silicon	KDS1554 or KDS1555 or 1N4448	Switching	DX-1581 DX-1394 DX-1054	SDSI00023– or SDSI00024– or SDSI00012–
D15–D16	Germanium	1N60P	Switching	DX-0162	SDGE00003P

FUSE

Ref. No.	Description	RS Part No.	Mfr's Part No.
F1	250V, 0.315A	HF-1249	251210060A

Note: *Mylar is a registered trademark of E.I.Du Pont de Nemours and Company.

ICs

Ref. No.	Description	RS Part No.	Mfr's Part No.
IC1	SXC1901F, C-MOS, Comparator	MX-5227	SISX1901F–
IC2	AN6914, C-MOS, Comparator or NJM2903D or μPC393C	MX-5453 MX-4543	SIAN6914–– or SINM2903D– or SIPC393C––

TRANSISTORS

Ref. No.	Description	RS Part No.	Mfr's Part No.
Q1	2SA733A (K) Switching PNP or	2SA-733A	ST2A733A-K or
	2SA733A (P) Switching PNP or	2SA-733A	ST2A733A-P or
	2SA733A (Q) Switching PNP or	2SA-733A	ST2A733A-Q or
	KTA1015 (Y) Switching PNP or	MX-4371	STKA1015-Y or
	KTA1015 (GR) Switching PNP	MX-4371	STKA1015-G
Q2–	2SC945A (K) Switching NPN or	2SC-945	ST2C945A-K or
Q3	2SC945A (P) Switching NPN or	2SC-945	ST2C945A-P or
	2SC945A (Q) Switching NPN or	2SC-945	ST2C945A-Q or
	KTC1815 (Y) Switching NPN or	2SC-1815	STKC1815-Y or
	KTC1815 (GR) Switching NPN or	2SC-1815	STKC1815-G or
	KTC1815 (BL) Switching NPN	2SC-1815	STKC1815-B

RESISTORS

Ref. No.	Description	RS Part No.	Mfr's Part No.
R1	Metal Film 10Mohm 1/2W ±0.5%	N-0482EFE	RM0HP106D*
R2	Metal Film 1.11Mohm 1/4W ±0.5%	N-0579EEE	RM0QUA02D*
R3	Metal Film 101kohm 1/4W ±0.5%	N-0580EEE	RM0QUA01D*
R4	Metal Film 10kohm 1/4W ±0.5%	N-0281EEE	RM0QU103D*
R5	Metal Film 1kohm 1/4W ±0.5%	N-0196EEE	RM0QU102D*
R6	Metal Film 1.64Mohm 1/4W ±1%	N-0673BEE	RM0QUA01F*
R7	Metal Film 164kohm 1/4W ±1%	N-0674BEE	RM0QUA02F*
R8	Metal Film 16.4kohm 1/4W ±1%	N-0669BEE	RM0QUA03F*
R9	Metal Film 1.64kohm 1/4W ±1%	N-0670BEE	RM0QUA04F*
R10	Metal Film 164ohm 1/4W ±1%	N-0676BEE	RM0QUA05F*
R11	Wire Wound 0.95ohm 1/4W ±1%		RW0QPR95FM
R12	Resist Wire 0.01ohm	W-3203	W5A1R6MT-Y
R13	Carbon 100kohm 1/4W ±5%	N-0371BEC	RCSQU104J*
R14	Carbon 100kohm 1/4W ±5%	N-0371BEC	RCSQU104J*
R15	Carbon 5.1kohm 1/4W ±5%	N-0252EEC	RCSQU512J*
R16	Carbon 100kphm 1/4W ±5%	N-0371BEC	RCSQU104J*
R17	Metal Film 192kphm 1/4W ±1%	N-0671BEE	RM0QUA06F*
R18	Metal Film 180kohm 1/4W ±1%	N-0387BEE	RM0QU184F*
R19	Carbon 33kohm 1/4W ±5%	N-0324EEC	RCSQU333J*
R20	Carbon 1kohm 1/4W ±5%	N-0196EEC	RCSQU102J*
R21	Carbon 12kohm 1/4W ±5%	N-0288EEC	RCSQU123J*
R22	Carbon 100kohm 1/4W ±5%	N-0371BEC	RCSQU104J*
R23	Metal Film 280kohm 1/4W ±1%	N-0672BEE	RM0QU284F*
R24	Metal Film 400kohm 1/4W ±1%	N-0415BEE	RM0QU404F*

Ref. No.	Description				RS Part No.	Mfr's Part No.
R25	Metal Film	7.3kohm	1/4W	±1%	N-0668BEE	RM0QU732F*
R26	Metal Film	1kohm	1/4W	±1%	N-0196BEE	RM0QU102F*
R27	Metal Film	20kohm	1/4W	±1%	N-0306BEE	RM0QU203F*
R28	Metal Film	6.8kohm	1/4W	±1%	N-0262BEE	RM0QU682F*
R29	Metal Film	22kohm	1/4W	±1%	N-0311BEE	RM0QU223F*
R30	Metal Film	22kohm	1/4W	±1%	N-0311BEE	RM0QU223F*
R31	Metal Film	330kohm	1/4W	±1%	N-0410BEE	RM0QU334F*
R32	Metal Film	22kohm	1/4W	±1%	N-0311BEE	RM0QU223F*
R33	Metal Film	330kohm	1/4W	±1%	N-0410BEE	RM0QU334F*
R34	Metal Film	22Mohm	1/2W	±1%	N-0585BFE	RM0HP226F*
R35	Carbon	5.1kohm	1/4W	±5%	N-0252EEC	RCSQU512J*
R36	Carbon	10kohm	1/4W	±5%	N-0281EEC	RCSQU103J*
R37	Carbon	100kohm	1/4W	±5%	N-0371BEC	RCSQU104J*
R38	Carbon	2kohm	1/4W	±5%	N-0213EEC	RCSQU202J*
R39	Carbon	10kohm	1/4W	±5%	N-0281EEC	RCSQU103J*
R40	Carbon	5.1kohm	1/4W	±5%	N-0252EEC	RCSQU512J*
R41	Carbon	100kohm	1/4W	±5%	N-0371BEC	RCSQU104J*
R42	Carbon	68kohm	1/4W	±5%	N-0354EEC	RCSQU683J*
R43	Carbon	51kohm	1/4W	±5%	N-0344EEC	RCSQU513J*
R44	Carbon	100kohm	1/4W	±5%	N-0371BEC	RCSQU104J*
R45	Carbon	5.1kohm	1/4W	±5%	N-0252EEC	RCSQU512J*
R46	Carbon	5.1kohm	1/4W	±5%	N-0252EEC	RCSQU512J*
R47	Carbon	5.1kohm	1/4W	±5%	N-0252EEC	RCSQU512J*

VARIABLE RESISTORS

Ref. No.	Description		RS Part No.	Mfr's Part No.
VR1	Semi-fixed	10KB	P-6751	176910090A
VR2	Semi-fixed	500KB	P-6750	176910140A

SURGE ABSORBER

Ref. No.	Description	RS Part No.	Mfr's Parr No.
SA1		HC-2502	255010040A

SWITCHES

Ref. No.	Description	RS Part No.	Mfr's Part No.
SW1	Rotary, Function	S-3210	181110110A
SW2	Push, Auto Shut-Off	S-7728	182110260A
SW3	Slide, Power & Range Hold	S-3794	183110150A
SW4	Slide, Buzzer & Continuity	S-3211	183110550A
SW5	Slide, 200mA & 10A	S-3795	183110140A or 183110141A
SW6	Key, 0-ADJ	S-3212	187010030A

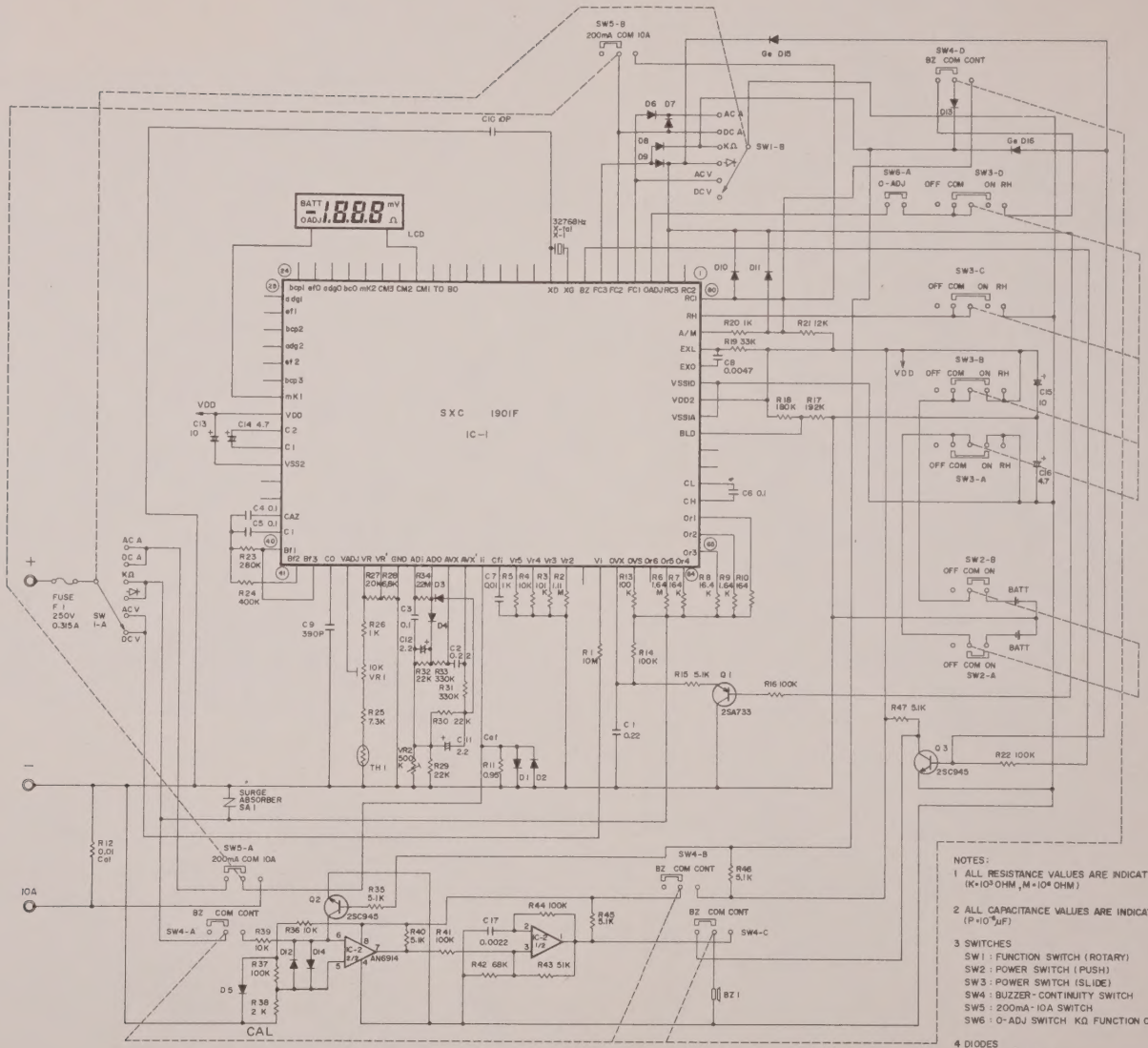
THERMISTOR			
Ref. No.	Description	RS Part No.	Mfr's Part No.
TH1	TD5-A135DH	T-1253	SDTH00005H

CRYSTAL			
Ref. No.	Description	RS Part No.	Mfr's Part No.
X1	32768Hz M56-16	MX-1030	391010070A

EXPLODED VIEW PARTS LIST

Ref. No.	Description	RS Part No.	Mfr's Part No.
1	Plate Ass'y, Indicator	Z-8012	M-00417
2	Cabinet, Top, Indicator		601210840A
3	Window		713510320A
4	Plate Ass'y, Control	Z-8013	M-00418
5	Cabinet, Top, Control		601210850A
6	Plate, Range		711610070A
7	Buzzer (BZ-1)	B-7110	272010010A
8	Case Ass'y (Non Repairable)	Z-8014	M-00419
9	LCD PCB Ass'y (Non Repairable)	XB-0263	42-095
10	Connector, Wire	J-5330	193910780A
11	Knob, Range	K-6102	652510460A
12	Knob, Auto Shut-Off	K-6103	659510800A
13	Knob, Zero Adjust	K-6104	659510810A
14	Cover, Battery	DB-0641	602110250A
15	Blind, Switch	N/S	851210390B
16	PCB Unit, Main	XB-0264	42-096
17	Clip, Fuse	F-1409	197303320C
18	Switch, Rotary, Function (SW-1)	S-3210	181110110A
19	Switch, Slide, Buzzer/Continuity (SW-4)	S-3211	183110550A
20	Switch, Slide, Power (SW-3)	S-3794	183110150A
21	Switch, Slide, 200mA/10A (SW-5)	S-3795	183110140A or 183110141A
22	Switch, Push, Auto Shut-Off (SW-2)	S-7728	182110260A
23	Switch, Key, Zero Adjust (SW-6)	S-3212	187010030A
24	Connector, Wire	J-5330	193910780A
25	Contact, Battery, +	B-0883	198110320A
26	Contact, Battery, + –	B-0884	198110330A
27	Contact, Battery, –	B-0885	198110340A
28	Terminal, Tester	HC-3541	194510090A
29	Contact, Switch, Buzzer (2 pcs), Ground (1 pc)	HC-3542	180810090A
30	Contact, Switch, Ground	CH-3543	180810080A
31	Fuse, 250V, 0.315A (F1)	HF-1249	251210060A
32	Screw, Tapping, 3 x 8BT-2-0, Bind Head		HTB23008SB
33	Screw, Tapping, 3 x 8PT-2-0, Pan Head		HTP23008SN
	Lead, Test (Radio Shack Cat. No. 278-704)	W-3045	315010010B
	Hardware Kit	HW-2200193	

SCHEMATIC DIAGRAM



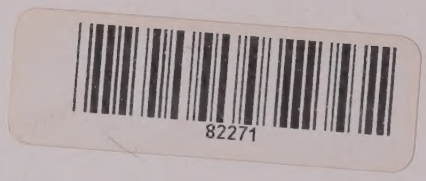
NOTES:

1 ALL RESISTANCE VALUES ARE INDICATED IN "OHM" ($K=10^3$ OHM, $M=10^6$ OHM)

2 ALL CAPACITANCE VALUES ARE INDICATED IN "μF" ($P=10^{-6}\mu F$)

3 SWITCHES
- SW1 : FUNCTION SWITCH (ROTARY)
- SW2 : POWER SWITCH (PUSH)
- SW3 : POWER SWITCH (SLIDE)
- SW4 : BUZZER-CONTINUITY SWITCH
- SW5 : 200mA-10A SWITCH
- SW6 : O-ADJ SWITCH KΩ FUNCTION ONLY

4 DIODES
- D1, D2 : SR1K-4
- D3—D14 : KDS1544 or KDS1555 or IN4448
- D15, D16 : IN60P



LINE	PART NUMBER	UNIT SELL	QTY	00181820
001	00C MS2200193	.00	1	OC 181588

RADIO SHACK, A DIVISION OF TANDY CORPORATION

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